

DISTRIBUTION STUDIES OF INTRODUCED TREES AND SHRUBS IN THE CAPE PENINSULA

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INTRODUCTION

Concern has been expressed in recent years about the rapid spread of certain introduced trees and shrubs in the vegetation of the South-Western Cape. These species were originally introduced for economic purposes, amongst others for the production of timber and the fixing of sand dunes. The introductions have since spread and now appear to be dominant in communities far from where they were originally planted.

It is becoming increasingly evident that these species are spreading to upper mountain slopes, and it has been suggested that they may constitute a distinct menace to the continued existence of the unique indigenous flora now restricted to these parts. The present work is designed to examine the high altitude distribution patterns of introduced species, and to provide a basis for assessing what is likely to happen if the present situation were to remain unchecked.

METHODS

The area selected for the survey consists of a 40 square mile tract of mountains in the northern part of the Cape Peninsula, extending from Table Mountain southwards to the Muizenberg Mountains. Throughout the area, intersections of the thousand yard grid lines on the 1 : 25,000 Trigonometrical Survey map of the Cape Peninsula (1951) were taken as sample points for plotting distribution patterns. (See Maps 1—9). Only those points above 500 feet and not lying in forestry plantations were examined. The points were located in the field by means of an altimeter and bearings taken from survey beacons with a prismatic compass.

At each sample site, details were recorded on a duplicated form as follows: position and altitude of site, numerically and physiognomically dominant indigenous species, average cover height and density, post-burn age, soil type, soil moisture, and aspect. Introduced species were recorded in terms of the approximate number of plants within a radius of 200 y rds of the sample point. Where high frequencies were encountered, a circular

area of 100 sq. meters was examined at the sample site to gain some idea of the densities attained in such communities. In addition, photographs were taken of the vegetation at most of the sample points.

The survey was restricted to those introduced species whose arborescent life-form would be likely to cause important changes in the structure and species-content of the local flora. It was found that thirteen species fell into this category. The survey was carried out in the period May 1959 to May 1960.

DISTRIBUTION PATTERNS

Distribution of introduced species is shown in Maps 1—9. The areas enclosed by the circumferences of the filled and unfilled circles are proportional to the number of plants found within 200 yards of the sample points. Numbers of plants above 200 and below 20 are represented by the largest and smallest circles given in the scale.

Of the 87 points examined, only four were found to be free from introduced species. The percentage occurrence of each species at sample points is listed in Table 1.

TABLE 1.

Percentage occurrence of introduced species at 87 sample points.

<i>Pinus pinaster</i> Ait.	83%	<i>Albizia distachya</i> (Vent.) McBride	7%
<i>Hakea gibbosa</i> Cav.	24%	<i>Acacia longifolia</i> Willd.	7%
<i>Acacia cyclops</i> A. Cunn.	20%	<i>Acacia melanoxylon</i> R. Br.	6%
<i>Acacia cyanophylla</i> Lindl.	17%	<i>Pinus pinea</i> L.	6%
<i>Pinus radiata</i> Don	11%	<i>Eucalyptus</i> sp.	5%
<i>Hakea suaveolens</i> R. Br.	11%	<i>Acacia mollissima</i> Willd.	1%
<i>Hakea acicularis</i> R. Br.	9%		

It is apparent from Table 1 that *Pinus pinaster* is very much more widely dispersed than the other species. However, it is evident from Diagram 1 that *P. pinaster* was most commonly found at low to moderately high local frequencies at sample points, and that very high frequencies of this species were uncommon. This is in contrast to *Hakea gibbosa* and *Acacia cyclops*, where very high frequencies were encountered in several places.

DISTRIBUTION IN RELATION TO ECOLOGY

The maximum development attained by introduced species in various communities and soil types is shown in Table 2. The sclerophyll community is by far the most widespread in the areas examined, and consists chiefly of xeromorphic shrubs with ericoid leaves and reed-like *Restionaceae*. Moist soils are relatively uncommon, as are soils with a high clay

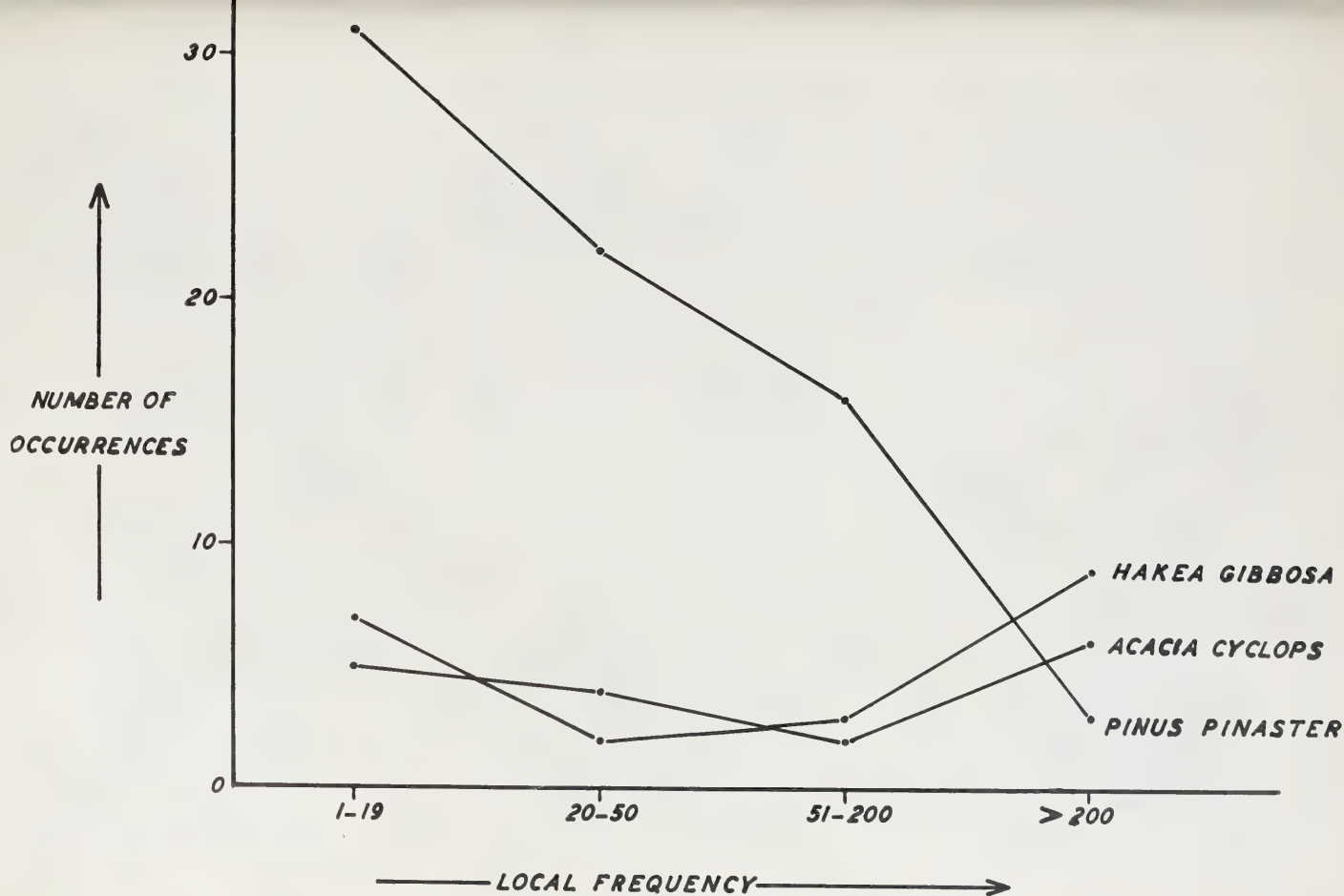


DIAGRAM 1. Graph showing the number of occurrences of various local frequencies of three of the most widespread species. Local frequency is expressed as the number of plants within 200 yards of the sample point.

content and those derived from decomposed granite, both of which are found at low altitudes. Broad-leaved forest, consisting of such species as *Podocarpus latifolius* (Thunb.) R. Br., *Halleria lucida* L., *Rapanea melanophloeos* (L.) Mez., and *Royena lucida* L., is chiefly confined to ravines. The broad-leaved bush community was mostly found on moist talus slopes near cliffs, at forest margins, and in the more exposed ravines. It is characterised by such species as *Pterocelastrus tricuspidatus* (Lam.) Sond., *Osyris compressa* (Berg.) A. DC., *Gymnosporia laurina* (Thunb.) Szyz., *Olea capensis* L., and *Phyllica buxifolia* L.

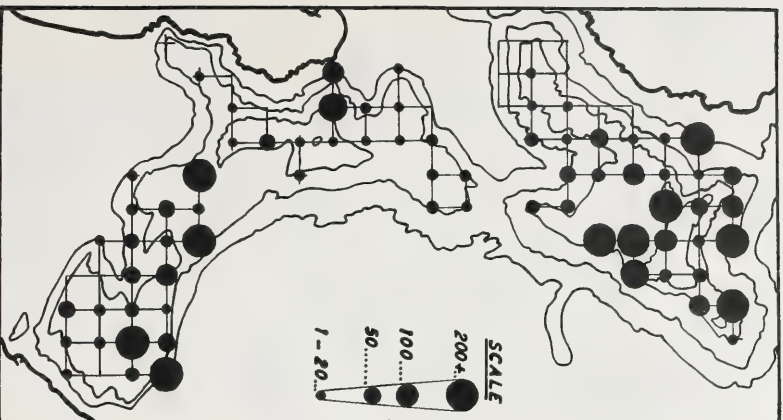
TABLE 2.

Maximum development attained by introduced species in various habitats.
a = abundant, c = common, f = frequent, o = occasional, r = rare

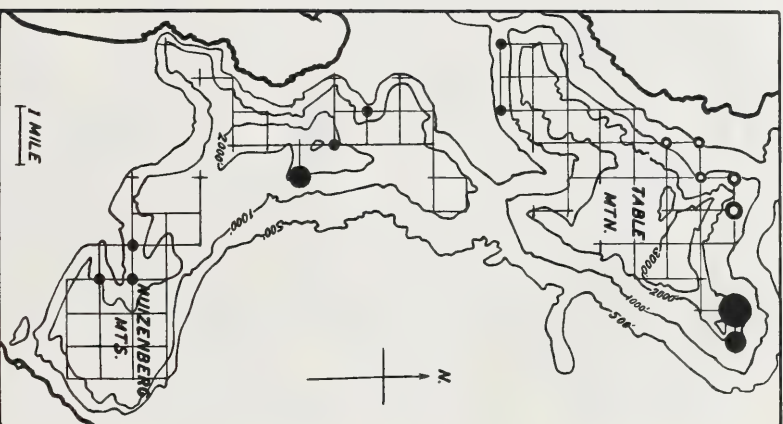
	<i>Pinus pinaster</i>	<i>Hakea gibbosa</i>	<i>Acacia cyclops</i>	<i>Acacia cyanophylla</i>	<i>Pinus radiata</i>	<i>Hakea suaveolens</i>	<i>Hakea acicularis</i>	<i>Albizia distachya</i>	<i>Acacia longifolia</i>	<i>Acacia melanoxylon</i>	<i>Pinus pinea</i>	<i>Eucalyptus</i> sp.	<i>Acacia mollissima</i>
I. SCLEROPHYLL													
(a) <i>Dry slopes:</i>													
Sandy soils	a	a	a	a	f	a	a	—	o	r	o	r	r
Clay soils	f	—	a	r	—	f	—	—	—	—	—	r	—
Granitic soils ..	f	a	r	r	—	a	—	—	—	—	r	—	—
(b) <i>Moist slopes:</i>													
Sandy soils	a	r	—	o	c	r	—	—	—	c	—	c	—
Clay soils	o	r	a	o	r	o	r	a	r	o	—	—	—
Granitic soils ..	o	r	o	—	—	—	—	a	—	—	o	—	—
(c) <i>Cliffs and rocky places with shallow soil</i> ..													
	c	—	—	o	r	—	—	—	f	r	—	—	—
IIa BROAD-LEAVED FOREST ..	r	—	—	—	—	—	—	—	—	—	—	—	—
IIb BROAD-LEAVED BUSH ..	o	—	—	a	r	—	a	o	r	r	r	o	—

It can be seen from Table 2 that *Pinus pinaster* occurred in all communities examined, although it was rare in broad-leaved forest. No other introduced species were recorded in this last community. The majority of introduced species were found to form significantly dense colonies on dry slopes in sclerophyll, an exception being *Albizia distachya*, which appeared to develop only on moist clay and granitic soils.

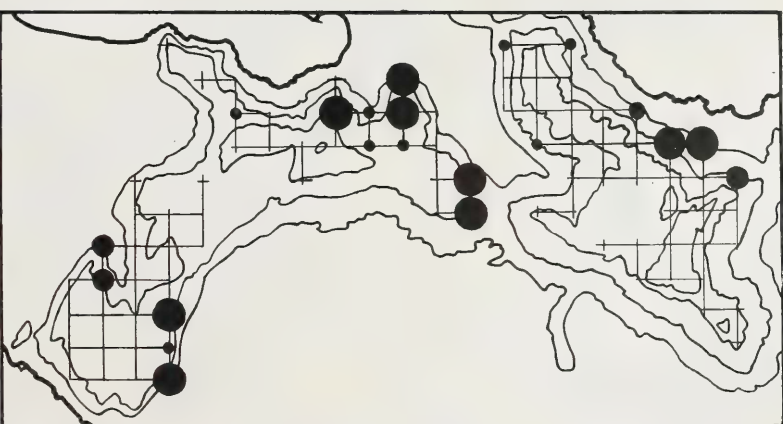
It is evident from the distribution maps that many of the less common species are rare at high altitude. It is considered that this is the outcome



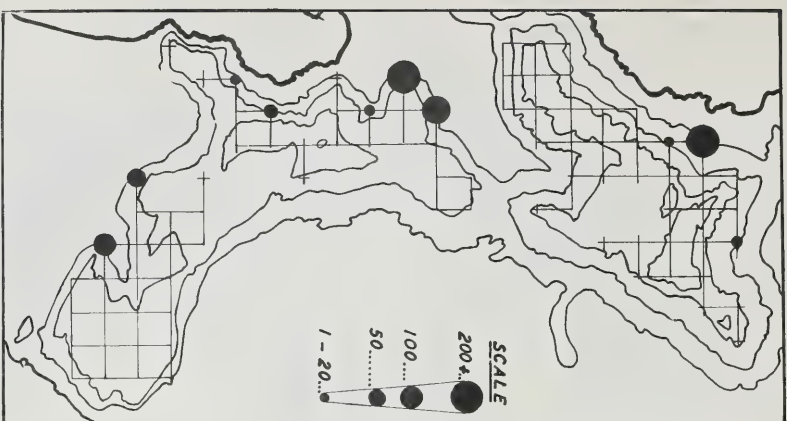
Map 1: *Pinus pinaster*



Map 2: *Pinus radiata* (●); *P. pinea* (○).



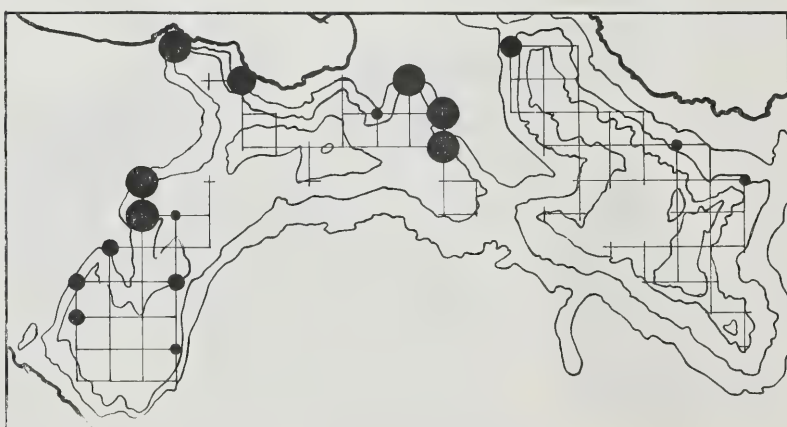
Map 3: *Hakea gibbosa*.



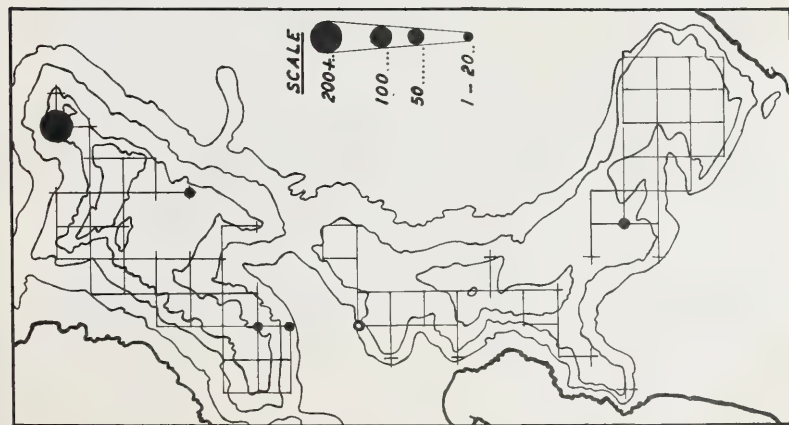
MAP 4: *Hakea suaveolens*.



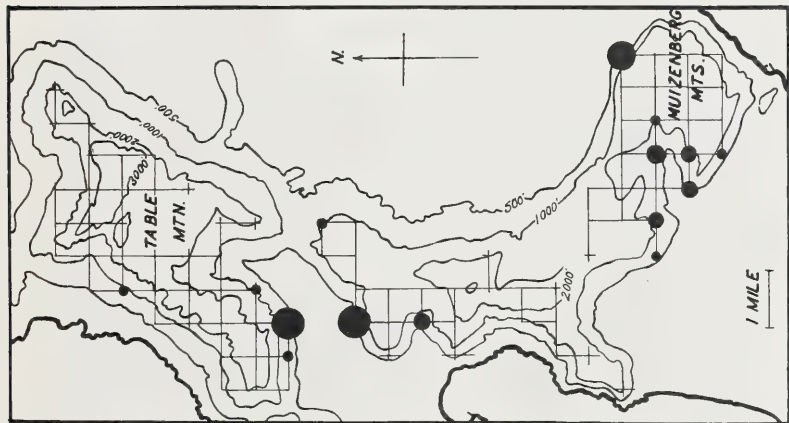
MAP 5: *Hakea acicularis* (●); *Acacia Longifolia* (○).



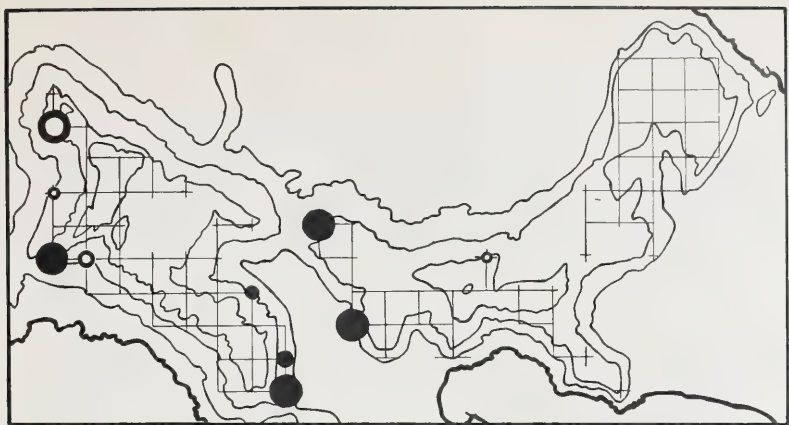
MAP 6: *Acacia cyclops*.



MAP 7: *Acacia melanoxylon* (●); *A. mollissima* (○).



MAP 8: *Acacia cyanophylla*.



MAP 9: *Albizia lophantha* (●); *Eucalyptus* sp. (○).

of absence of local infection sources in such areas, rather than adverse habitat conditions. Only minor differences exist between the climates of low and high altitudes, chiefly involving slightly lower temperatures and the occurrence of wind-borne summer mists on upper slopes.

Fire is a factor which may be of some significance. While no detailed study of this could be made in the present survey, it was clear in several cases that burning of vegetation containing dispersed plants of *Acacia cyclops* and *Hakea* spp. led to the formation of very dense stands of these species. This was not apparent in *Pinus pinaster*, which is generally held to be highly sensitive to injury from fire especially when young. (Zahn and Neethling, 1929). It should be added that no less than 28% of the sample points had been burnt in the previous five years.

DISCUSSION

It is clear from the above survey that a significantly high degree of infection by introduced species exists throughout the area examined. The most widespread species, *Pinus pinaster*, is most commonly found in low to moderately high concentrations, but seldom in very dense stands. Dispersal to a given site is probably highly efficient, and some factor such as a long generation time, or frequent burning off of young individuals must be postulated for the rarity of dense colonies.

In contrast to this, the next most common species, *Hakea gibbosa*, was much less widely dispersed, although it was found in high densities in many places. The woody, fire-resistant fruits of *Hakea gibbosa* rarely open to liberate seed unless the parent plant is damaged by fire or mechanical injury. After burning therefore, very large quantities of seed are liberated. The resulting seedlings grow rapidly and form dense stands on the newly colonised burnt area, where competition is probably at a low level. The seed is winged, and can be carried by wind to adjoining areas, there to develop into mature plants and to form new colonies on the occurrence of subsequent fires. This hypothesis is borne out by the fact that a very large percentage of the plants in a stand of *Hakea gibbosa* are all approximately the same age.

A similar argument may be postulated to explain the analogous distribution pattern of *Acacia cyclops*. In this case, fire probably serves to char and rupture the extremely tough coats of seeds lying dormant near the parent plants, leading to the production of large numbers of individuals where only a few existed before. However, judging from the wider age distribution of plants in dense colonies, it seems likely that there is not quite the same dependence on fire for the production of new individuals as in *Hakea gibbosa*.

The remaining species were found individually at less than 20%, and collectively at 41% of the points examined. While this is a significant proportion of the total, it is felt that any general conclusions regarding distribution must await further autecological studies. It should be made clear however that many of these species are capable of forming dense colonies in a wide range of habitats. (See Table 2).

Finally, one must examine the likely future of the indigenous vegetation if the present spread of introduced species were to remain unchecked. While the present distribution of *Pinus pinaster* includes relatively few cases of very high densities, available data indicates that the species is capable of forming dense stands in a wide range of habitats. In such dense stands, records show that only a very small proportion of the indigenous flora is able to survive. However, limited survival may be possible on cliff faces and rocky places, where shallow and scattered pockets of soil preclude the formation of dense colonies of introduced species. The indigenous flora of such localities tends to be rather specialised however. A slightly greater survival percentage was recorded in dense stands of *Hakea gibbosa* and *Acacia cyclops*, although in both cases it was still remarkably low. Similar remarks apply to the less widely dispersed species.

CONCLUSIONS

The above data indicates that a widespread invasion of upper mountain slopes by introduced species has taken place. Unless checked, it is probable that this invasion could ultimately result in the formation of dense communities of introduced species, containing only a very limited proportion of the present indigenous flora. Such dense infections are likely to occur throughout a wide range of habitats, with the exception of the broad-leaved forest community.

SUMMARY

The distribution patterns and ecology of a number of introduced trees and shrubs were examined on Table Mountain and an adjoining range on the Cape Peninsula, South Africa. Intersections of lines of a thousand yard grid were used as sample points for plotting distributions in the 40 square mile area.

Introduced species were found in the immediate vicinity of 95% of these points. *Pinus pinaster* Ait. was by far the most widely dispersed species, occurring at 83% of the sample points, usually at low to moderately high concentrations. The next most widely dispersed species, *Hakea gibbosa* Cav. and *Acacia cyclops* A. Cunn. were found at 24% and 20%

of the points respectively, and were often present in very high concentrations. The remaining ten species were found in varying concentrations at a total of 41% of the sample points.

Ecological relationships are discussed. It was found that the more common species were capable of forming significantly dense colonies in a wide range of habitats, with the exception of the broad-leaved forest community.

It is suggested that only a small proportion of the indigenous flora is likely to survive if the present invasion were to remain unchecked.

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